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SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF GRADUATE STUDIES

MECHANICAL ENGINEERING DEPARTMENT

Proportions of an axial Wind Turbine to be used in North of Sudan

Thesis submitted in partial fulfillment to the college of engineering for* the *requirement of

(M. Sc. (mechanical

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Abstract

This study has been carried out to exploit the wind energy to lift water from deep well for domestic use in the north of Sudan where the wind is available.

The result of this study gave the estimation of proportions of five blades with tubes on the concave sides with supporting horizontal axis against the wind to achieve the task.

الخلاصه

تم اعداد هذه الدراسه لاستغلال طا قه الرياح لرفع مياه جوفية للاستخدامات المنزليه فى شمال السودان حيث الرياح متوفره

هذة الدراسه خلصت الى حساب ابعاد تربينه هوائيه تتكون من خمسه ريش مقوسة بمحور افقى لاستغلال الطاقة فى رفع كميه الماء المطلوبة.

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Contents

SYMBOLS

		Units
A	Rotor swept area	m^2
A_1	Area on the upstream side of the rotor	m^2
A_2	Area on the downstream side of the rotor	m^2
a	Axial induction factor	
a'	Tangential induction factor	
B	Number of blades	
D	Drag force	N
D_p	Pump piston diameter	m
d_d	Diameter of the delivery pipe	m
d_p	Diameter of the pump rod	m
C	Chord width	m
C_D	Drag coefficient	

C_L	Lift coefficient	
C_P	Power coefficient	
C_T	Torque coefficient	
L	Pump stroke	m
L_d	Length of the delivery pipe	m
L_s	Span length	m
F_a	Axial force	N
F_d	Driving force	N
f	Friction factor	
P_a	Atmospheric pressure	N/m^2
P_x	Upstream pressure	N/m^2
P_y	downstream pressure	N/m^2
$\mathbf{P}_b$	blade power	$watt$
V	Wind speed	$m/\sec$
V_1	Upstream wind speed	$m/\sec$
V_2	Downstream wind speed	$m/\sec$
V_r	Relative speed	$m/\sec$
U	Speed of the rotor	$m/\sec$
T_b	Torque on the blade	Nm

GREEK SYMBOLS

α	Angle of attack	degree
β	Blade setting angle	degree
ϕ	Angle between the relative velocity and the Rotor speed	degree
λ	Tip speed ratio	
λ_r	Local tip speed ratio	
ρ	Air density	kg/m^3
ρ_s	Steel mass density	kg/m^3
ω	Angular speed of the rotor	$rad/\sec$
Ω	Yaw angular speed	$rad/\sec$

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